Prediction, estimation and attribution

Exercises

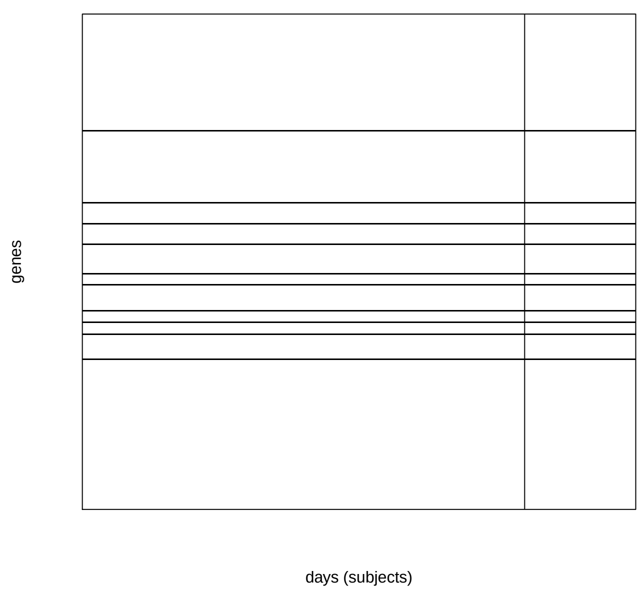
Consider the following hypothetical microarray study: $n = 400$ subjects participate in the study, arriving one per day in alternation between Treatment and Control (day 1 Treatment, day 2 Control, day 3 Treatment, etc.). Each subject is measured on a microarray of $p = 200$ genes. The 400×200 data matrix X has independent normal entries

$$X_{ij} \overset{\text{ind}}{\sim} \mathcal{N}(\mu_{ij}, 1)$$

1. Suppose that most of μ_{ij} are 0, only for $j = 30, 48, 57, 65, 84, 92, 113, 128, 143, 195$

$$\mu_{ij} = 0.5 \quad i \text{ odd (Treatment)} \quad \mu_{ij} = -0.5 \quad i \text{ even (Control)}$$

See the following Figure, where the lines correspond to genes with average gene expression of 0.5 for Treatments and -0.5 for Controls:



In the first random Forest analysis (RF-I), the 400 subjects were randomly divided into a training set of 320 and a test set of 80.

The second random Forest analysis (RF-II), uses the subjects from days 1 to 320 for the training set and from days 321 to 400 for the test set.

(a) Do you expect the test error of RF-II to be lower than 50%?

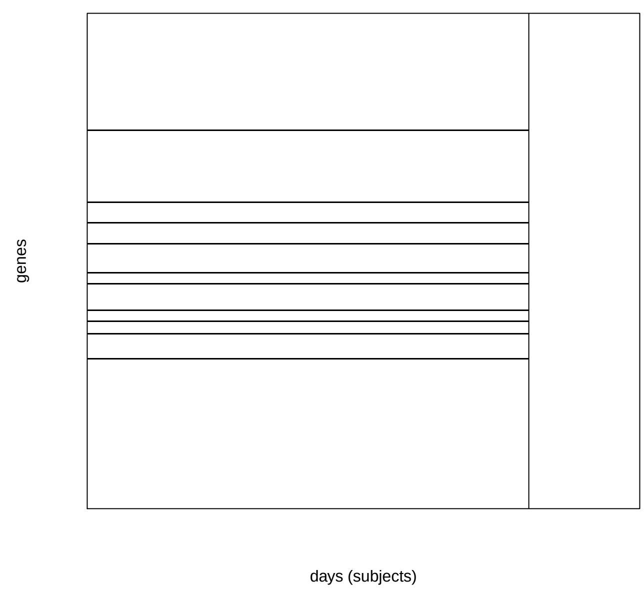
(b) Do you expect any difference in training prediction error between RF-I and RF-II ?

(c) How many genes large Variable Importance score do you expect to find with RF-I?

2. Now suppose that for $j = 30, 48, 57, 65, 84, 92, 113, 128, 143, 195$

$\mu_{ij} = 2 \quad i = 1, 3, \ldots, 317, 319$ (Treatment) $\quad \mu_{ij} = -2 \quad i = 2, 4, \ldots, 318, 320,$ (Control)

and for everything else $\mu_{ij} = 0$. See the following Figure:



(d) Do you expect the test prediction error of RF-II to be lower than 50%?

(e) Do you expect the training prediction error of RF-I to be higher than the training prediction error of RF-II ?